

Lakkala, M., Ilomäki, L., & Kantosalo, A. (2011). Which pedagogical practices and methods best support learning digital competences? In *Linked portal*. Brussels: European Schoolnet.
<http://linked.eun.org/web/guest/in-depth5>

The authors of these documents or materials ("the works") are Liisa Ilomäki, Minna Lakkala and Anna Kantosalo. The copyright in the works belongs to EUN Partnership AISBL who commissioned them. The works shall not be modified or adapted without the express written consent of the copyright owner. Any reproduction of the works by any means must include this copyright notice.

Which pedagogical practices and methods best support learning digital competences?
Minna Lakkala, Liisa Ilomäki and Anna Kantosalo, University of Helsinki, Finland

1. Introduction

There were two main aspects considered in answering the question. First, we had to consider what issues to include in the definition of “digital competences”. Studies about pedagogical practices and methods do not necessarily directly use the term “digital competence” but discuss, for example, “digital literacy”, “information seeking skills” or “ICT skills”; partly because there is not yet any established way to use the concept (see also the answer about defining the concept of digital competence), and partly because it is easier to do empirical research on some narrower skill that can be defined more accurately. In the answer below, original author’s definition of the skill is mentioned when reviewing the results if relevant, to make it clear what kind of skill learning has been investigated in the referred articles.

Second, also the concept “pedagogical practices and methods” can mean multiple issues. We have interpreted it to mean various types of tasks, ways of working or types of activities and practices according to which pupils or students are directed or instructed to act by the teacher in school lessons or in other pedagogical setting that has been the object of study in the reviewed publications. Some articles include results of learning activities from informal learning settings, in which there is not any systematic pedagogical effort included in organizing the participants’ activities.

According to the review, it appears that the teaching of digital competence has not been the main object of study in recent research. Rather, the development of digital competence or related skills is often mentioned as a side-effect of using digital technology in an educational setting that focuses on other learning outcomes, such as inquiry skills or domain knowledge. Even though the main focus of the review is on school education, some studies reporting experiences from higher education are also included to give more examples and viewpoints in the answer.

2. Various methods to teach digital competences

Digital competence develops in problem-oriented, technology-rich and long-term settings

There were no studies found where pedagogical methods supporting digital competence was directly investigated through empirical study settings, or the methods used were very descriptive, explorative or narrative. The reason for that probably is the complex and gradually developing nature of such competences, which makes them difficult to investigate through controlled experimental methods. Some studies focused on investigating methods of using information and communication technology (ICT) in education generally or in teaching some subject domain content (e.g. Mitchell & Dunbar, 2006; Robin, 2008), and referred to digital competence or related concept as one element in that more overarching activity. Some studies examined teachers' opinions through surveys (e.g. Benes, 2008) or students' self-reflections (e.g. Bouhnik & Giat, 2009; Lam, 2009; Lei, 2010) about the good ways to support the development of digital competence or related skills. Some articles provided policy-related suggestions for supporting students' digital competence, without presenting explicit evidence-based results (e.g. Pruulmann-Vengerfeldt, Kalmus & Runnel, 2008).

Based on the reviewed articles, many researchers appear to share the opinion that the pedagogical settings and methods supporting the development of digital competence include rich and integrated use of various technical tools, and wide range of activities that are based on complex and challenging tasks, including, for instance, students' own knowledge creation or product construction, solving of multidisciplinary problems and collaborative activities (Pruulmann-Vengerfeldt et al., 2008; Tierney, Bond & Bresler, 2006), or project work (Erstad, 2010). Similarly, Labbo (2006) stated, speaking about the development of new literacies, that the transformation of teaching practices (literacy instruction) occur in classrooms where computer technologies are used throughout the day and across the curriculum. In the reviewed articles, it was emphasized that skills and competencies related to technology should not be seen narrowly, consisting only on mechanical skills of using some software application. Likewise, also the methods for learning such skills require practicing them in settings where multiple technological tools are used in an integrated way in "authentic", complex tasks and for as real purposes as possible. Examples of such activities and tasks were rapid prototyping with realistic resources and tools (Dlodlo & Beyers, 2009); problem-solving games that give student teams complex, real-life contextualized problems, asking them to systematically use various information sources to create solutions (Turcsányi-Szabó, Bedő, & Pluhár, 2006); or digital storytelling (Robin, 2008).

One study examined how information literacy skills, meaning information handling, proper use of digital information resources etc., should be supported in schools. Aznar & González (2010) investigated how to support information problem solving through a "webquest" method in secondary education. The method consisted of a task where students work in groups to produce a report on a certain issue; each student specialized in one sub-topic, searching for and sharing information from the Internet about it for a joint, integrated report. The researchers concluded that the method, e.g., provided students with a possibility to work with complex topics, practice cooperative skills and face challenges of information handling and usage of ICT.

Two studies (Ilomäki & Rantanen, 2007; Rutledge, Duran & Carroll-Miranda, 2007) reported a research endeavour where the development of ICT skills was examined in a long-term setting where laptops were given to a group of students, and their extensive usage was implemented in the teaching practices of the group for three years. Conclusions from the studies were that rich and versatile usage of technology through laptops both in school and out school settings and in various activities, projects and school subjects developed necessary basic digital competences of all participants. In addition, as

Ilomäki and Rantanen (2007) reported, voluntary possibilities to participate in challenging ICT-related projects provided some students with ICT expertise that resembles professional expertise.

Also studies that grounded their evidence on students' own reporting of the increase in their competences in a pedagogical intervention, described similar conclusions about the types of practices that may support digital competencies. Lam (2009) investigated secondary school students' experiences from an international inquiry-based collaboration project, where students used various technological tools such as Knowledge Forum, Slide, Wiki and Google Docs. In addition to content learning, students reported that the project improved, for instance, their skills on critical thinking and proper writing skills on an on-line knowledge building environment, and ICT competence by using some Web 2.0 applications. Based on a survey and interviews conducted to seventh- and eighth-grade students and teachers, Lei (2010) concluded that the influence of technology usage on student outcomes depends more on the *quality* than *quantity* of technology use. He argued that academic achievement should not be the only a criterion for evaluating the meaningfulness of technology use; some other outcomes are also important components of school education, including student behaviour, attitude, self-esteem, digital literacy and career aspiration.

Ryberg and Dirckinck-Holmfeld (2008) argued that in order to understand how young peoples' digital literacies are best supported, we should empirically investigate how they actually work with digital media in concrete learning situations. In the study, they investigated a setting where young people from different countries were brought together in an international symposium and had to work collaboratively on solving a challenging, open-ended problem. The researchers emphasized that children's game playing and experimental use of ICT does not necessarily provide them with complex, creative and productive competences or learning capabilities. Some insights indicated that the complex media literacies demonstrated by the young in the investigated case were especially related to the very problem-oriented and open-ended learning design in the setting.

From print literacy to digital literacy

One line of research in the reviewed articles was the examination of the ways and methods for teaching digital literacy as an alternative to traditional "print literacy".

Moran, Ferdig, Pearson, Wardrop and Blomeyer (2008) reported results from a meta-analysis of 20 articles about the use of digital tools (hypertext, hypermedia, Web pages etc.) to enhance literacy acquisition of middle school students. Only quantitative experimental or quasi-experimental studies were accepted in the analysis. Although the researchers grounded their study on the current discussion about digital literacy, they mainly examined aspects of traditional literacy, such as motivation or reading comprehension. They concluded that digital learning environments and tools can have an impact on literacy learning, but more experimental research is needed to examine technology as a component of middle-school literacy curriculum and pedagogy.

Two articles reported studies about efforts to change pedagogical practices in schools to support "multiliteracies". Both articles referred to the approach of *New London Group* to teach multiliteracies. Tan and McWilliam (2009) investigated the possibilities to implement new literacy pedagogies with digital media in two different contexts: In an elite school and in a preparatory school for immigrant students. In the elite school, a student-led, peer-to-peer online learning initiative (a multimodal Web 2.0 Student Media Centre) was implemented. In the migrant students' school, the researchers explored, with the school staff, various options for creating multiple pathways for the students through the use of digital learning technologies. In the study of Tan and Guo (2009), the researchers worked intensively for over two years with a middle school teacher designing activities to advance

students' critical multimedia literacy. The tasks included the analysis and production of various kinds of texts forms: fiction books, brochures, videos, Web-pages and multimedia presentations. Noteworthy is that either of the two studies actually reported results about the successfulness of the pedagogical methods to promote multiliteracies. The main result from both studies was that it is difficult to implement new pedagogical approaches in mainstream schooling where teachers' and students' prevailing practices as well as institutional curriculum goals and assessment criteria are shaped by traditional print and academic literacies.

Jones (2007) described in his article some experiences from a college course titled "Critical Literacy" focusing on the practices of reading and writing with computers and the Internet. In the course, students examined the history of literacy as well as their own literate practices with print and digital texts. During the course, students read articles about the topic, had face-to-face and web-based discussions about them and wrote an essay as a final product. There were not any empirical analysis or results presented in the article, but it provides an example of a course aiming at promoting students' digital literacy skills.

Summary

In the reviewed articles, the role of digital competence or related concept was not the main object of study, but a side-effect in learning something else through using digital technology. Studies were often descriptive case studies or surveys based on self-reflections; both are problematic research methods for getting strict empirical evidence.

As a summary of the viewpoints in the articles we may conclude that digital competence or related skills develop in problem-oriented, technology-rich and long-term settings where technology is used in a meaningful context. In such settings, various technological tools are used in integrated ways. Such settings include wide range of activities that are based on complex and challenging tasks including, for instance, students' own knowledge creation or product construction, solving of multidisciplinary problems, collaborative activities and project work. In many articles, it was emphasized that skills related to using technology should not be seen narrowly; therefore, also the methods for learning the skills require practicing them through complex, challenging and "authentic" activities.

One special area discussed in some articles was how to change literacy education from focusing on traditional print literacy towards promoting digital literacy or multiliteracies. According to the studies, the role of traditional literacy appears to be very strong in conventional school practice, which makes it difficult even to experiment with innovative methods to support multiliteracies.

3. Method for answering the question

Search procedures

The searches were conducted using EBSCOhost, which is an on-line retrieval system of scientific articles related to educational, psychological and behavioural sciences. The searches were targeted to two databases in the system: Academic Search Complete and Education Research Complete. The results from these databases were narrowed down by the following restrictions: Articles were to be peer reviewed, in English, published in between 2005-2010 (originally in between 2000-

2010, but due to vast amounts of irrelevant hits this was further restricted) and finally the full text was to be available through EBSCOhost with the rights purchased by the University of Helsinki.

The search words used in the process were mainly derived from the vocabulary of the original questions collected from practitioners and their synonyms. In addition to these, some terms were added using the professional knowledge of the researchers involved in the process.

The process was started with a more general search shared with all the questions related to Digital Competence. This was conducted to roughly estimate the workload and adjust parameters for the search. The search words used in the general search were:

- digital competence* (all text)
- digital skill* (all text)
- digital literac* (all text) AND education (subject terms) AND school (subject terms)
- ICT skill* (all text) AND education (subject terms) AND school (subject terms)
- ICT competenc* (all text) AND education (subject terms) AND school (subject terms)
- ICT literac* (all text) AND education (subject terms) AND school (subject terms)

In addition the following searches were conducted especially for this theme, including searches that produced 0 results:

- ICT competenc* (all text) AND methods (subject terms)
- ICT skill* (all text) AND methods (subject terms)
- ICT literac* (all text) AND methods (subject terms)
- digital literac* (all text) AND methods (subject terms)
- digital literac* (all text) AND pedagog* (subject terms)
- ICT literac* (all text) AND pedagog* (subject terms)
- ICT skill* (all text) AND pedagog* (subject terms)
- ICT competenc* (all text) AND pedagog* (subject terms)
- ICT competenc* (all text) AND problem-based learning (subject terms)
- ICT skill* (all text) AND problem-based learning (subject terms)
- ICT literac* (all text) AND problem-based learning (subject terms)
- digital literac* (all text) AND problem-based learning (subject terms)
- digital literac* (all text) AND inquiry-based learning (subject terms)
- ICT competenc* (all text) AND inquiry-based learning (subject terms)
- ICT skill* (all text) AND inquiry-based learning (subject terms)
- digital literac* (all text) AND metacognition (subject terms)
- digital literac* (all text) AND constructivism (subject terms)
- ICT skill* (all text) AND constructivism (subject terms)
- ICT competenc* (all text) AND constructivism (subject terms)
- ICT literac* (all text) AND inquiry-based learning (subject terms)
- digital literac* (all text) AND case-based learning (subject terms)
- ICT literac* (all text) AND case-based learning (subject terms)
- ICT skill* (all text) AND case-based learning (subject terms)
- ICT competenc* (all text) AND case-based learning (subject terms)
- ICT competenc* (all text) AND situational learning (subject terms)
- ICT skill* (all text) AND situational learning (subject terms)
- ICT literac* (all text) AND situational learning (subject terms)
- digital literac* (all text) AND situational learning (subject terms)
- digital literac* (all text) AND embedded learning (subject terms)

- ICT literac* (all text) AND embedded learning (subject terms)
- ICT skill* (all text) AND embedded learning (subject terms)
- ICT competenc* (all text) AND embedded learning (subject terms)
- ICT competenc* (all text) AND metacognition (subject terms)
- ICT skill* (all text) AND metacognition (subject terms)
- ICT literac* (all text) AND metacognition (subject terms)
- ICT literac* (all text) AND constructivism (subject terms)

(The term indicated between the parentheses describes which parts of the database the search words were directed to.)

As Table 1 shows, the search word “ICT skill*” used together with other terms produced most hits, but in general the search word “ICT competenc*” produced the best quality hits. In addition to the searches into the databases, a manual search of scientific journals related to the theme, covering the latest year of publications, was conducted in the University of Helsinki Minerva-library at the campus of Behavioural sciences. More articles were also found through the reference listings of articles that came up in the searches. Some of the reference articles were also familiar to the researchers from previous experiences with the field of study.

Table 1. Presenting the results in a matrix, where numbers in each square represent Number of positive results/Total number of results.

	digital literac*	ICT skill*	ICT competenc*	ICT literac*
methods	5/24	10/29	6/9	4/7
pedagog*	0/1	0/3	0/0	0/1
problem-based learning	0/1	2/4	1/1	1/2
inquiry-based learning	0/2	0/2	1/1	0/0
metacognition	1/3	0/0	0/0	0/0
constructivism	0/3	2/2	1/1	0/0
case-based learning	0/0	0/0	0/0	0/0
situational learning	1/1	0/0	0/0	0/0
embedded learning	0/0	0/0	0/0	0/0

Some articles were later excluded because closer examination revealed that they were not relevant for answering the question. All in all, 22 research papers were used in composing the answer.

4. References

- Allen, S. M. (2007). Information literacy, ICT, high school, and college expectations. *Knowledge Quest*, 35(5), 18-24.
- Aznar, V., & González, J. (2010). Interactive resources in secondary education: Design and application. *International Journal of Learning*, 17(2), 181-194.
- Benes, P., Mudrak, D., Prochazka, J., Rambousek, V., & Stipek, J. (2008). Research of ICT education in the Czech Republic. *Problems of Education in the 21st Century*, 5, 24-34.
- Dadzie, P. S. (2009). Information literacy in higher education: Overview of initiatives at two Ghanaian universities. *African Journal of Library, Archives & Information Science*, 19(2), 165-175.
- Dlodlo, N., & Beyers, R. N. (2009). The experiences of South-African high-school girls in a Fab Lab environment. *Proceedings of World Academy of Science: Engineering & Technology*, 37, 423-430.
- Erstad, O. (2010). Educating the Digital Generation. *Nordic Journal of Digital Literacy*, 1, 56–70.
- Iilomäki, L., & Rantanen, P. (2007). Intensive use of ICT in school: Developing differences in students' ICT expertise. *Computers & Education*, 48(1), 119-136.
- Jones, D. C. (2007). Thinking critically about digital literacy: A learning sequence on pens, pages, and pixels. *Pedagogy*, 7(2), 207-221.
- Labbo, L. (2006). Literacy pedagogy and computer technologies: Toward solving the puzzle of current and future classroom practices. *Australian Journal of Language and Literacy*, 29(3), 199-209.
- Lam, P. H. (2009). Quasi-experimental research into the effects of an international collaboration project on Hong Kong secondary school students' learning motivation. *International Journal of Learning*, 16(7), 325-337.
- Lei, J. (2010). Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology*, 41(3), 455-472.
- Lovell, S., & Baker, S. (2009). Digital narratives of youth transition. *Youth Studies Australia*, 28(4), 52-59.
- Mitchell, D., & Dunbar, C. (2006). Learning and development in the nursery setting: The value of promoting emergent information and communications technology skills. *Child Care in Practice*, 12(3), 241-257.
- Moran, J., Ferdig, R. E., Pearson, P. D., Wardrop, J., & Blomeyer, R. L. (2008). Technology and reading performance in the middle-school grades: A meta-analysis with recommendations for policy and practice. *Journal of Literacy Research*, 40(1), 6-58.

- Pruulmann-Vengerfeldt, P., Kalmus, V., & Runnel, P. (2008). Creating content or creating hype: Practices of online content creation and consumption in Estonia. *Cyberpsychology*, 2(1), 1-8.
- Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into Practice*, 47(3), 220-228.
- Rutledge, D., Duran, J., & Carroll-Miranda, J. (2007). Three years of the New Mexico laptop learning initiative (NMLLI): Stumbling toward innovation. *AACE Journal*, 15(4), 339-366.
- Ryberg, T., & Dirckinck-Holmfeld, L. (2008). Power users and patchworking - An analytical approach to critical studies of young people's learning with digital media. *Educational Media International*, 45(3), 143-156.
- Tan, J. P., & McWilliam, E. (2009). From literacy to multiliteracies: Diverse learners and pedagogical practice. *Pedagogies*, 4(3), 213-225.
- Tan, L., & Guo, L. (2009). From print to critical multimedia literacy: One teacher's foray into new literacies practices. *Journal of Adolescent & Adult Literacy*, 53(4), 315-324.
- Tierney, R. J., Bond, E., & Bresler, J. (2006). Examining literate lives as students engage with multiple literacies. *Theory Into Practice*, 45(4), 359-367.
- Turcsányi-Szabó, M., Bedő, A., & Pluhár, Z. (2006). Case study of a TeaM challenge game—e-PBL revisited. *Education & Information Technologies*, 11(3), 341-355.